Marshall Space Flight Center Propulsion Systems Department (PSD) Knowledge Management (KM) Initiative

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Abstract

NASA Marshall Space Flight Center's Propulsion Systems Department (PSD) is four months into a fifteen month Knowledge Management (KM) initiative to support enhanced engineering decision making and analyses, faster resolution of anomalies (near-term) and effective, efficient knowledge infused engineering processes, reduced knowledge attrition, and reduced anomaly occurrences (long-term). The near-term objective of this initiative is developing a KM Pilot project, within the context of a 3-5 year KM strategy, to introduce and evaluate the use of KM within PSD.

An internal NASA/MSFC PSD KM team was established early in project formulation to maintain a practitioner, user-centric focus throughout the conceptual development, planning and deployment of KM technologies and capabilities within the PSD. The PSD internal team is supported by the University of Alabama's Aging Infrastructure Systems Center of Excellence (AISCE), Intergraph Corporation, and The Knowledge Institute.

The principle product of the initial four month effort has been strategic planning of PSD KM implementation by first determining the "as is" state of KM capabilities and developing, planning and documenting the roadmap to achieve the desired "to be" state. Activities undertaken to support the planning phase have included data gathering; cultural surveys, group work-sessions, interviews, documentation review, and independent research. Assessments and analyses have been performed including industry benchmarking, related local and Agency initiatives, specific tools and techniques used and strategies for leveraging existing resources, people and technology to achieve common KM goals.

Key findings captured in the PSD KM Strategic Plan include the system vision, purpose, stakeholders, prioritized strategic objectives mapped to the top ten practitioner needs and analysis of current resource usage.

Opportunities identified from research, analyses, cultural/KM surveys and practitioner interviews include: executive and senior management sponsorship, KM awareness, promotion and training, cultural change management, process improvement, leveraging existing resources and new innovative technologies to align with other NASA KM initiatives (convergence: the big picture).

To enable results based incremental implementation and future growth of the KM initiative, key performance measures have been identified including stakeholder value, system utility, learning and growth (knowledge capture, sharing, reduced anomaly recurrence), cultural change, process improvement and return-on-investment.

The next steps for the initial implementation spiral (focused on SSME Turbomachinery) have been identified, largely based on the organization and compilation of summary level engineering process

models, data capture matrices, functional models and conceptual-level systems architecture. Key elements include detailed KM requirements definition, KM technology architecture assessment, evaluation and selection, deployable KM Pilot design, development, implementation and evaluation, and justifying full implementation (estimated Return-on-Investment).

Features identified for the notional system architecture include the knowledge presentation layer (and its components), knowledge network layer (and its components), knowledge storage layer (and its components), User Interface and capabilities.

This paper provides a snapshot of the progress to date, the near term planning for deploying the KM pilot project and a forward look at results based growth of KM capabilities with-in the MSFC PSD.

Background and Overview

NASA, Marshall Space Flight Center's Propulsion Systems Department (PSD) is engaged in a fifteen month knowledge management pilot project. The University of Alabama's Aging Infrastructure Systems Center of Excellence (AISCE) and Intergraph Corporation developed a KM evaluation proposal, focusing on specific PSD operational processes and propulsion components and secured funding through a grant award to execute a KM pilot project. The pilot project involves the evaluation of the "as is" state of KM capabilities within the PSD and development of strategy to achieve the desired "to be" state. The tactical approach involves deploying a highly focused proof of concept KM tool suite applied to the PSD design engineering analysis process and the failure and anomaly investigation/resolution process, specifically as they pertain to SSME turbomachinery. This focused approach enables demonstration of KM system functionality against measurable success criteria and results based outward growth of KM capabilities as additional resources and sponsorship are obtained.

The near-term objective of this initiative is a working KM Pilot project, within the context of a 3-5 year KM strategy, to introduce and evaluate the use of KM within PSD. Desired results from implementing the PSD KM pilot include improvements in:

- ✓ Knowledge access – Effective, efficient, informed engineering decision making, analytical processes and products
- ✓ Responsiveness – faster resolution of anomalies and reduction in anomalies
- ✓ Prevention – reduced attrition of knowledge capitol.

The Strategic Plan establishes a vision, blueprint and approach to develop, initiate, and execute an effective knowledge management strategy for PSD. The plan is much broader and more ambitious than the tightly focused SSME turbomachinery Pilot initiative being implemented in calendar year 2006.

The PSD KM team follows a four-phased KM Strategic Deployment Roadmap as depicted in Figure 1 below. The roadmap is based on more than 5 years of cumulative industry research, leveraging the best practices for a successful KM strategy and deployment.

This approach allows PSD to roll out a robust knowledge management strategy and system— properly aligned with the NASA, MSFC and PSD strategies.
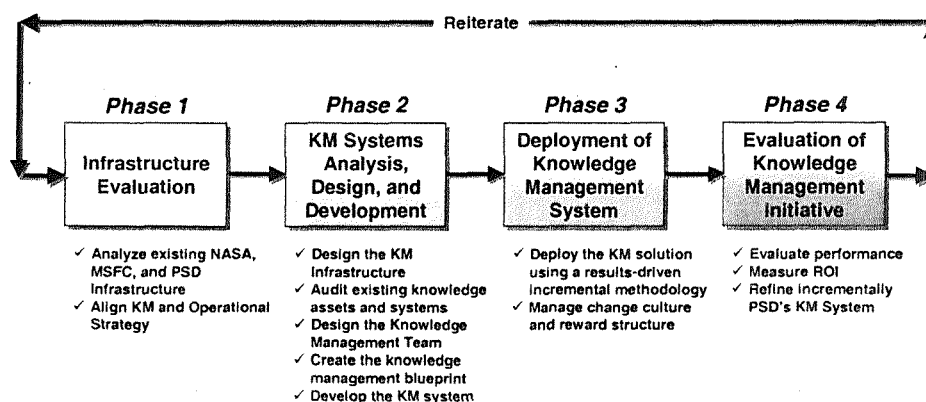
Reiterate

Phase 1	Phase 2	Phase 3	Phase 4
Infrastructure Evaluation	KM Systems Analysis, Design, and Development	Deployment of Knowledge Management System	Evaluation of Knowledge Management Initiative

✓ Analyze existing NASA, MSFC, and PSD Infrastructure
✓ Align KM and Operational Strategy

✓ Design the KM Infrastructure
✓ Audit existing knowledge assets and systems
✓ Design the Knowledge Management Team
✓ Create the knowledge management blueprint
✓ Develop the KM system

✓ Deploy the KM solution using a results-driven incremental methodology
✓ Manage change culture and reward structure

✓ Evaluate performance
✓ Measure ROI
✓ Refine incrementally PSD's KM System

Figure 1: KM Strategic Deployment Roadmap

The top three priorities for the PSD KM Strategic Plan are:

1. Improve safety, reliability, and quality
2. Reduce risks / impact of knowledge attrition associated with NASA's ageing workforce
3. Align operations and resources with Agency, NASA field centers and industry partners.

Project Scope

The specific scope of work for the MSFC PSD KM effort is:

- Research PSD KM requirements
- Develop a KM Strategic Plan for implementation of improved knowledge management capabilities for PSD
- Define a single integrated web-enabled application to meet these requirements
- Develop a proof-of-concept pilot of the integrated KM application
- Test the effectiveness and efficiencies of this pilot
- Estimate the financial and non-financial benefits to be derived from full implementation of the integrated KM application

This project's focus is to facilitate KM for specific pre-defined activity flows identified by PSD leadership.

Approach & Methodology

The Team's strategic approach was to complete all required activities in four phases, as shown in Figure 2 below. All phases are results-driven within the framework of KM Enterprise Architecture.
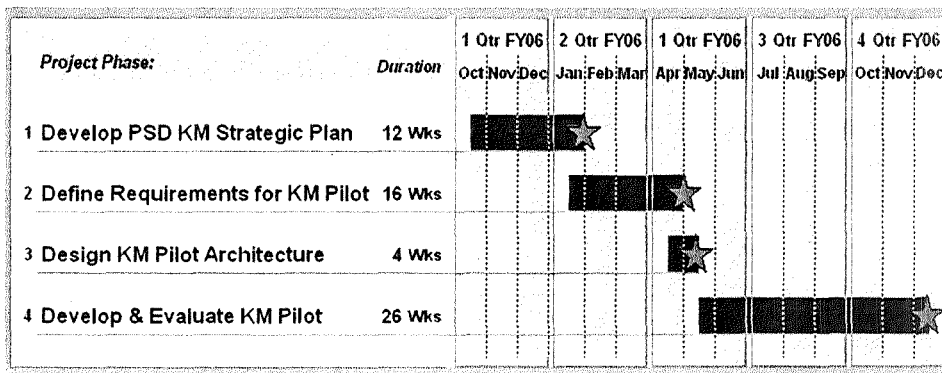
Project Phase:	Duration	1 Qtr FY06 Oct Nov Dec	2 Qtr FY06 Jan Feb Mar	1 Qtr FY06 Apr May Jun	3 Qtr FY06 Jul Aug Sep	4 Qtr FY06 Oct Nov Dec
1 Develop PSD KM Strategic Plan	12 Wks	■■■★				
2 Define Requirements for KM Pilot	16 Wks		■■■★			
3 Design KM Pilot Architecture	4 Wks			■★		
4 Develop & Evaluate KM Pilot	26 Wks			■■■■■■■■★		

Figure 2: Four-phased approach to building the KM Pilot

Progress-to-Date

The principle product of the initial four month effort has been strategic planning for the PSD KM implementation by first determining the "as is" state of KM capabilities, followed by developing, planning and documenting the roadmap to achieve the desired "to be" state.

The PSD KM Strategic Plan follows the Enterprise Architecture concept, shown in Figure 3 below. This concept is a guiding framework for design and development of operational processes and their supporting information technologies. It addresses strategy, operations (people and process) and technology in that order.
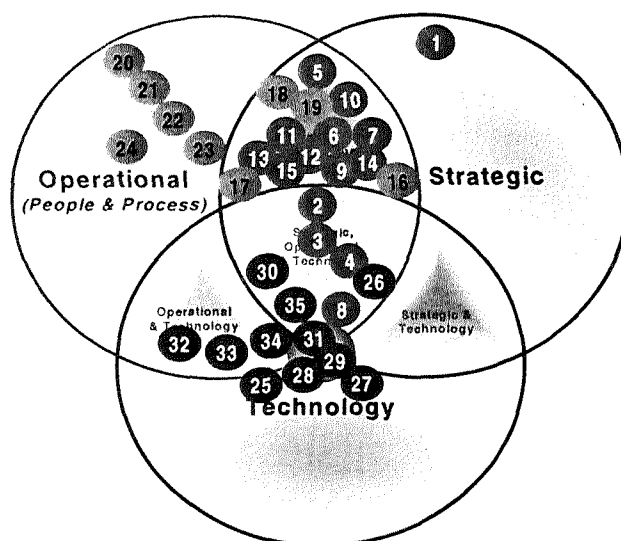
Figure 3: Relationship of KM Plan Steps to Enterprise Architecture Level

The Plan describes 35 steps, grouped into the three Enterprise Architecture levels:

- 15 steps (numbered blue circles) at the strategic level
- 9 steps (numbered green circles) at the operational (process) level
- 11 steps (numbered red circles) at the technology level.

A summary of the 35 Enterprise Architecture steps follows:

Strategic Steps

The Strategic KM Plan steps are:
1. Establish PSD KM system Target Vision *(completed)*
2. Define PSD KM system Purpose *(completed)*
3. Develop PSD KM system Objectives *(completed)*
4. Prioritize PSD KM system Objectives *(completed)*
5. Align PSD KM mission and objectives with MSFC and NASA missions and objectives
6. Charter and form a PSD KM Management Team
7. Align PSD KM Management Team with other NASA KM initiatives.
8. Leverage other existing and future KM resources.
9. Establish Key Performance Indicators (KPI's)
10. Develop a Stakeholder Management strategy and plan
11. Develop a Cultural Change strategy and plan
12. Develop a Risk Management strategy and plan
13. Determine what knowledge content is to be captured & managed (explicit & tacit)
14. Identify potential Communities of Practice
15. Audit, measure, and reiterate improvements

Operational (Process) Steps

The Operational (Process) KM Plan steps are:
16. Define start-up, maintenance, and expansion processes for PSD Knowledge Management implementation and support
17. Identify and prioritize PSD mission-oriented, mission-critical processes to be supported by knowledge management

18. Identify and prioritize PSD support processes to be supported by knowledge management
19. Identify and prioritize PSD strategic management processes to be supported by knowledge management
20. Capture and model "As Is" process activities and details
21. Define process metrics for all processes
22. Identify areas of process waste (wait time, rework, etc.)
23. Design alternative "To Be" process
24. Perform rough-order-of magnitude cost-benefit analysis for implementation of "To Be" process

Technology Steps

The PSD KM solution should be compatible with and leverage the existing NASA / MSFC infrastructure (hardware, software, networking, account management, etc.) wherever possible and appropriate to do so. The Technology KM Plan steps are:

25. Leverage existing collaborative technologies while embracing new tools that support the PSD mission.
26. Integrate collaborative technologies and new tools into PSD's KM framework.
27. Integrate the PSD KM system with other NASA applications where possible to do so. (Integration efforts undertaken should add high value to knowledge capital, workflow, efficiency and output.)
28. Implement a robust and NASA-tuned taxonomy and thesaurus
29. Improve upon and maintain the NASA-tuned taxonomy and thesaurus to enhance value to the organization.
30. Negotiate better access to mission required vendor / supplier's databases and knowledge bases to support PSD in execution of its NASA mandated charter.
31. Link departmental portal/user interface efforts to processes, workflows, work product, knowledge-bases, repositories, communities of practices, other NASA entities, and vendor/suppliers to achieve greater collaboration and competitive advantage.
32. Leverage existing technologies that exist within NASA Agency, NASA Centers, MSFC and its contractors and vendors.
33. Build upon existing infrastructure (physical and application) to accelerate solution delivery time and reduce costs for the MSFC PSD KM Systems.
34. Leverage new / emerging technologies to support and optimize PSD operational requirements, capabilities and mission.
35. Put a PSD IT Portfolio Management Strategy and program in place to effectively manage the MSFC PSD technology investments.

Strategic Planning Activities

Activities undertaken to support the Team's structured methodology for Phase 1 (Completed January 31, 2006) included data gathering, through documentation review, individual interviews, cultural surveys, group work-sessions, and independent research.

Assessments and analyses, including industry benchmarking, related local and Agency initiatives, specific tools and techniques used, and strategies for leveraging existing resources, people and technology to achieve common KM goals.

Data Gathering

The PSD KM team followed a structured sequence for data gathering. More specifically, the team:
   ✓ Reviewed NASA / MSFC / PSD documents / artifacts to become familiar with current PSD operations.
   ✓ Performed independent research into KM best practices, lessons learned, and other

NASA KM initiatives and web sites.
- ✓ Facilitated a two-day Group Work-Session for PSD Strategic KM Planning:
- ✓ Produced a target PSD KM System Vision
  - Developed the PSD strategic KM objectives
  - Assessed current use of PSD resources to achieve the PSD KM System Vision
- ✓ Surveyed personnel to assess PSD's KM and organizational change culture.
- ✓ Conducted a series of structured interviews, in which we:
  - Identified high-level process activities
  - Defined and validate process steps
  - Captured process details and data sources

Assessment and Analysis

During and after data gathering, the team performed assessment and analysis activities. Team member activities included:

- ✓ Creation of summary-level Activity Models for activities identified during interviews and normalized variations among multiple Activity Models of like activities.
- ✓ Developed a Process Analysis Data Matrix (Figure 4 below) and populated it with data collected from the process detail capture interviews the team identified:
  - 15 external data sources including 8 from the SSME tech server, 2 from Boeing web pages, and 5 from other external web sites.
  - 34 internal data sources including 15 from MSFC web pages, 18 from other NASA web pages, and 1 from the "Jetson" server.
  - 28 custom software applications.
  - The team also identified requirements for 11 interfaces to other NASA Centers, 20 interfaces to external legacy systems and 18 interfaces to internal legacy systems.

Figure 4: Process Analysis Data Matrix

- ✓ Analyzed and "normalized" responses for process steps
- ✓ Defined summary-level Process Models for activities identified by team members during individual interviews and "normalized" variations among multiple Activity Models of like activities. The summary level Activity Model is shown in figure 5 below.
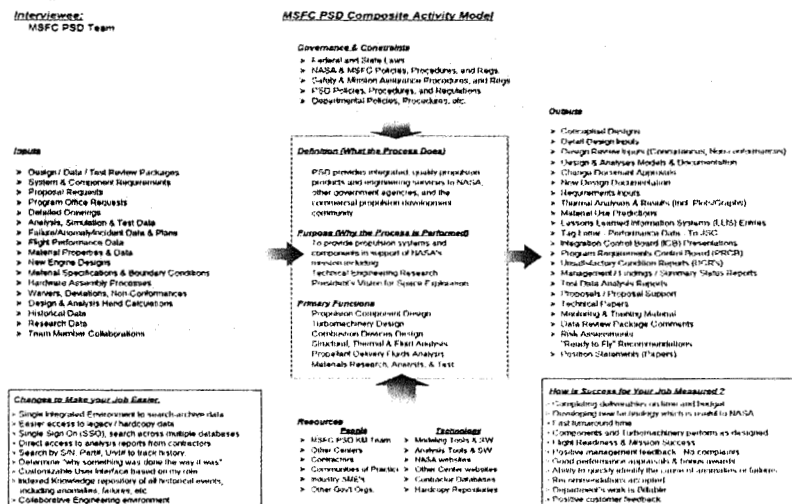
Figure 5: Summary Level Activity Model

✓ Developed a PSD Data Sources Analysis Matrix to help gauge patterns and frequencies of use of each data source.

✓ Defined a summary-level KM conceptual data model to describe graphically the data sources required by our proposed single integrated web-enabled KM application. The conceptual data model is shown below as figure 6.
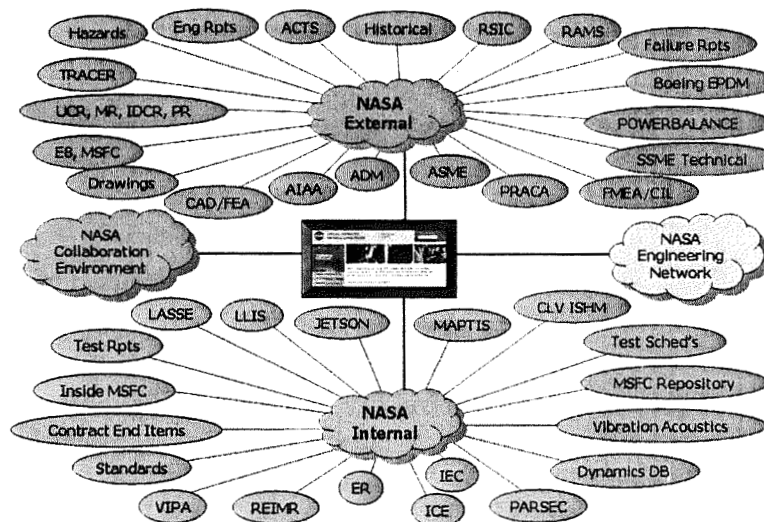

Figure 6: Conceptual Data Model

Key Findings

Key findings captured during the PSD KM Strategic Planning process included the system vision, purpose, stakeholders, prioritized strategic objectives mapped to the top ten practitioner needs and analysis of current resource usage.

System Vision

The PSD KM team defined the following KM strategic system vision:

> *"The PSD Knowledge Management (KM) System provides complete and immediate access to NASA's and the aerospace industry's collective intellect in accomplishing NASA's mission."*

Purpose

The team defined the following KM strategic system vision:

The PSD KM System serves as a single source to disseminate and infuse intellectual assets into PSD strategies, processes, methods and operations. It enables cutting edge, world-class propulsion system design and development capability.

Benefits

The PSD KM System benefits include:

- ✓ Improved safety
- ✓ Optimized resource utilization
- ✓ Improved efficiency
- ✓ Improved engineering discernment

- ✓ Improved hardware readiness assessment
- ✓ Enhanced core capabilities of PSD
- ✓ Reduced costs

Stakeholders

The PSD KM stakeholders are the individuals who are impacted, (both voluntarily and involuntarily), by the PSD KM system. The Stakeholders are represented by:

- ✓ Engineering (Design, Analysis, Test, Manufacturing, Component, Systems)
- ✓ Configuration Management
- ✓ Logistics
- ✓ Chief Engineers
- ✓ Program Managers
- ✓ Other NASA centers and HQ
- ✓ Astronauts
- ✓ Taxpayers

- ✓ Congress
- ✓ Academia
- ✓ Department and division management
- ✓ Project Managers
- ✓ Safety and Mission Assurance
- ✓ Subcontractors
- ✓ Database owners
- ✓ IT
- ✓ Information security

Strategic Objectives and Top Ten Practitioner Needs

The team constructed a comparative table (Figure 7 below) to the level of alignment between the day-to-day (tactical) Top Ten Needs, identified during the interviews, and the eight Strategic Objectives defined by participants in the Strategic Assessment & Planning Event.
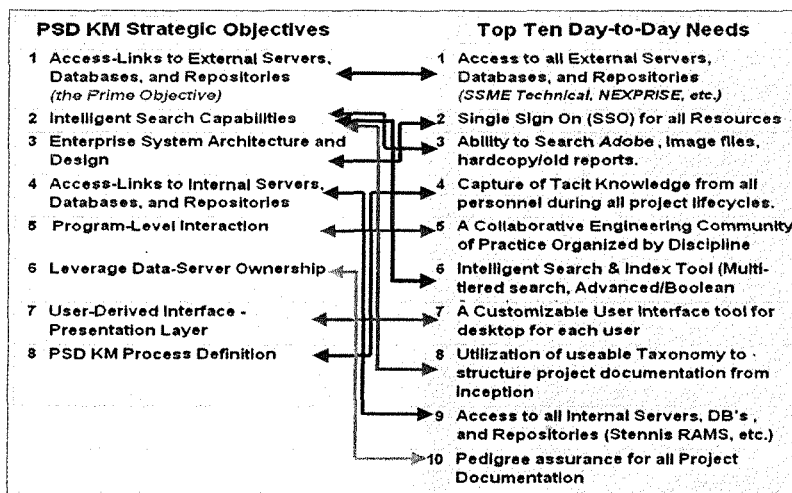

PSD KM Strategic Objectives	Top Ten Day-to-Day Needs
1 Access-Links to External Servers, Databases, and Repositories (the Prime Objective)	1 Access to all External Servers, Databases, and Repositories (SSME Technical, NEXPRISE, etc.)
2 Intelligent Search Capabilities	2 Single Sign On (SSO) for all Resources
3 Enterprise System Architecture and Design	3 Ability to Search Adobe, Image files, hardcopy/old reports.
4 Access-Links to Internal Servers, Databases, and Repositories	4 Capture of Tacit Knowledge from all personnel during all project lifecycles.
5 Program-Level Interaction	5 A Collaborative Engineering Community of Practice Organized by Discipline
6 Leverage Data-Server Ownership	6 Intelligent Search & Index Tool (Multi-tiered search, Advanced/Boolean
7 User-Derived Interface - Presentation Layer	7 A Customizable User Interface tool for desktop for each user
8 PSD KM Process Definition	8 Utilization of useable Taxonomy to structure project documentation from inception
	9 Access to all Internal Servers, DB's, and Repositories (Stennis RAMS, etc.)
	10 Pedigree assurance for all Project Documentation

Figure 7: Comparison of Strategic Objectives and Top Ten Practitioner Needs

Other Findings

Cultural Change and KM Surveys identified those areas that require management attention if KM is to be successful. Respondents rated themselves collectively as "adequate" and trending towards "good" in the areas of cultural change. They perceived themselves as being culturally ready to accept change.

Responses to 23 of 46 KM survey questions identified a need for immediate attention in the following major categories:

- ✓ Management commitment to KM   (6 questions)
- ✓ Processes supporting KM   (8 questions)
- ✓ Organizational structure supporting KM   (4 questions)
- ✓ KM Awareness, Training, and Education   (5 questions)

Opportunities

Opportunities identified from research, analyses, cultural / KM surveys and practitioner interviews include executive and senior management sponsorship, KM awareness, promotion and training, cultural change management, process improvement, leveraging existing resources and new innovative technologies to align with other NASA KM initiatives (convergence: the big picture).

PSD identified significant opportunities, based upon KM "best practices" to:

- ✓ Align its operations and data more closely with NASA Headquarters and Centers through integration and knowledge sharing technologies, techniques, tools, and practices.
- ✓ Establish virtual and formal Communities of Practices across engineering disciplines and harness both individual and team tacit and explicit knowledge.
- ✓ Scan, capture, index, and store electronically selected existing hard-copy content to provide timely access when required. This will decrease content retrieval times and increase its individual and team output efficiency.
- ✓ Create and allow easy access to selected NASA internal databases and repositories utilizing "single login" (LDAP) technology while adhering to NASA IT security policies.
- ✓ Design, develop, deploy and leverage a personalized, user-centric, customizable workspace environment to support increased individual task level accessibly and output.
- ✓ Leverage its knowledge management initiative as an enabler for cultural change and transformation to better achieve goals and mission.
- ✓ Leverage its knowledge management initiative to improve the effectiveness of communications channels among agency, centers, vendors and suppliers.
- ✓ Leverage its knowledge management initiative as an enabler to combat loss of explicit and tacit knowledge due to personnel transfer or retirement. Institutional memory is lost as personnel and records are moved or replaced.
- ✓ Leverage its knowledge management initiative to enhance core capabilities through procedural tutorials and computer base training modules.

The team linked focused recommendations to specific findings and opportunities, as shown in the Table below:

Findings / Opportunities	Recommendations / Resolutions
1 Existing **processes not enforced.** *Multiple variations of same processes* Some interviewees believed there are no processes.	✔ Implement a **process capture and improvement program.** Model and document "As Is" and "To Be" processes. Define key performance indicators (KPIs)
2 No organized method to **capture and re-use tacit knowledge.**	✔ Establish a PSD **KM system with interactive improvements.**
3 No easy way to access **explicit knowledge** from contractors and vendors.	✔ Investigate **DoD-Managed Space Shuttle Support - Master Data Management (MDM)** application and framework
4 Lack of **single sign-on capability** creates a psychological barrier to use of existing systems, regardless of the actual time and effort required to access these systems using multiple sign-ons.	✔ Investigate / leverage **NICE (Lightweight Directory Application Protocol [LDAP])** MSFC initiatives
5 No **common collaborative environment** for sharing information by disciplines and no structured way to leverage existing pockets of collaboration.	✔ Leverage **existing and new collaboration tools.** Link portal / users interfaces / collaboration to processes, workflow, work product, knowledgebases,repositories and
6 CAIB report noted that NASA does not exhibit the **characterisitics of a learning organization** and requires significant changes to its culture for future success. In contrast, PSD staff perceive themselves as **ready and willing to make changes.**	✔ Implement a **program of cultural change** to evolve PSD into a **learning organization culture.**
7 No system for **"pedigree" / revision control** of knowledge artifacts.	✔ Implement **enterprise content management** (ECM), **document management, and taxonomy** (meta-data)
8 No existing PSD **taxonomy** for KM system	✔ Investigate, leverage and adopt **either JPL or Xerox taxonomy** so as to align with **other NASA operations**

Findings / Opportunities	Recommendations / Resolutions
9 No existing PSD KM system but **many KM intiatives** occuring within NASA units	✔ Design KM system that works for PSD. Simultaneously, investigate, adopt, and leverage **learnings and best practices from other NASA operations.**
10 No existing PSD **Enterprise Content Management** System component for KM system	✔ Investigate, leverage and adopt either *Documentum* or *Vignette* ECM, to **align with other NASA operations**
11 Many **disparent systems and appications** within PSD and other NASA units	✔ Design PSD user interface and KM system that work **overall systems convergance and integration,** leveraging IT investments across PSD/other NASA operational units
12 No PSD **IT Portfolio Management** currently in place to leverage full benefits of existing and new technologies	✔ Implement a PSD Portfolio Management Program to **align KM investments** with other NASA efforts and **maximize ROI (cost avoidance).**
13 Limited existing PSD **formal management, measurement and structured growth** of knowledge assets.	✔ Investigate, adopt and use KM **best practice techniques and tools** (i.e knowledge audits, SWOTs, knowledge mapping, best practices, continuous process improvement, KM succes criteria, ROI analysis)
14 Limited existing PSD formal management, measurement and structured growth of **organizational - departmental performance metrics (KPI's)**	✔ Investigate, adopt and use **best practice measurement techniques and tools** (i.e proven succes criteria for customer, fiinancial, operational (process), and organizational learning metrics (KPI's)
15 Limited existing PSD IT **search capabilities** in place to locate knowledge and artifacts efficiently	✔ Implement a PSD **Intelligent Search** capabilty for users as part of KM / ECM system

Figure 8 below shows the relationships of individual opportunities / recommendations listed above to the three overlapping levels (strategic, operational, and technical) of the Enterprise Architecture. Importance may be discerned by proximity of the individual opportunities / recommendations to the center of the diagram. Enterprise architecture priorities are based on relevance and alignment between the PSD KM team developed strategic objectives, and these opportunities / recommendations.
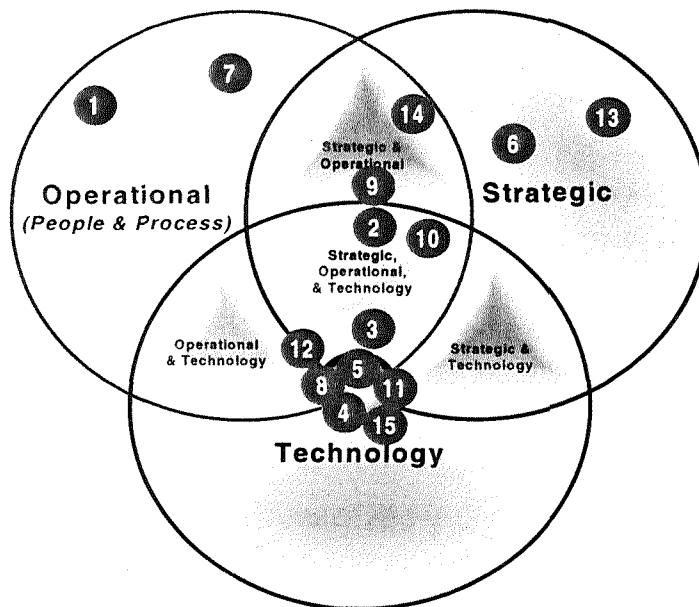

Figure 8: Relationship of Findings/Opportunities to Enterprise Architecture levels.

Measurements:

To enable results-based incremental implementation and future growth of our KM initiative, we have identified key performance measures that include stakeholder value, system utility, learning and growth (knowledge capture, sharing, and reduced anomaly recurrence), cultural change, process improvement and return-on-investment.

The objective of performance measurement is to improve the performance of the PSD organization, not merely individual performance. To facilitate acceptance of performance measurement, the PSD KM team will recommend recognition and rewards for managers and workers who use measurement to improve verifiable performance.

The concept of performance measurement is straightforward: You get what you measure; and you can't manage a program or project unless you can measure it. Key Performance Indices (KPI) measurements focus on what is to be accomplished and provides feedback on progress toward objectives. If results differ from objectives, PSD can analyze the gaps in performance and make adjustments. KPI's provide a framework for both performance management and cultural change management and, therefore, overall evolution of the organization.

Next Steps

PSD's next steps for the initial implementation spiral (the KM Pilot, focused on SSME Turbomachinery) have been identified, largely based on the organization and compilation of summary level engineering process models, data capture matrices, functional models and conceptual-level systems architecture. Key elements include:

- ✓ Detailed KM requirements definition
- ✓ KM pilot architecture and technology assessment, evaluation and selection
- ✓ Deployable KM Pilot design, development, implementation and evaluation
- ✓ Justifying full implementation (estimated Return-on-Investment)

The next steps are identified as Phases 2 through 4 in Figure 9 below.

Project Phase:	Duration	1 Qtr FY06 Oct Nov Dec	2 Qtr FY06 Jan Feb Mar	1 Qtr FY06 Apr May Jun	3 Qtr FY06 Jul Aug Sep	4 Qtr FY06 Oct Nov Dec
2 Define Requirements for KM Pilot	16 Wks		▬▬ ☆			
3 Design KM Pilot Architecture	4 Wks			▬☆		
4 Develop & Evaluate KM Pilot	26 Wks			▬▬▬▬	▬▬▬▬	▬☆
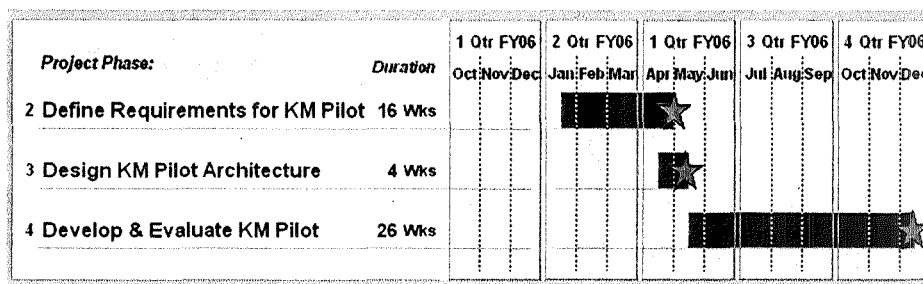
Figure 9: Next Steps

The steps, approach, and methodology that will be used to perform the work required to complete this project are outlined below.

Next Steps - Phase 2

Phase 2 of the next steps is defining the KM Pilot Requirements. The following steps will be completed during this phase:

1. KM Architecture Guidelines / Requirements
2. NASA IT Standards, Architecture, and Security
3. Content Management
4. Taxonomy/ontology
5. Linguistics
6. Business Rules
7. Personalization for Users and Disciplines
8. Vendor assessments: performance, qualifications, vision, and ability to execute

In order to complete the KM system requirements, the Intergraph team will continue to further refine and decompose the two processes already defined at the top level for the KM pilot implementation as they specifically pertain to the SSME Turbomachinery. These processes are the:

- ✓ PSD Design Engineering Analysis Process
- ✓ Failure / Anomaly Analysis Process

Working through the PSD Executive sponsor, the Intergraph KM team will continue interview sessions with selected PSD team members. The decomposition effort will be accomplished using the same IDEF 3 modeling tools used to build the present process models.

The KM technology evaluation and selection process is a series of logical steps following Intergraph's five-phased SOLUTION ENGINEERING™ methodologies framework as shown in figure 10 below.
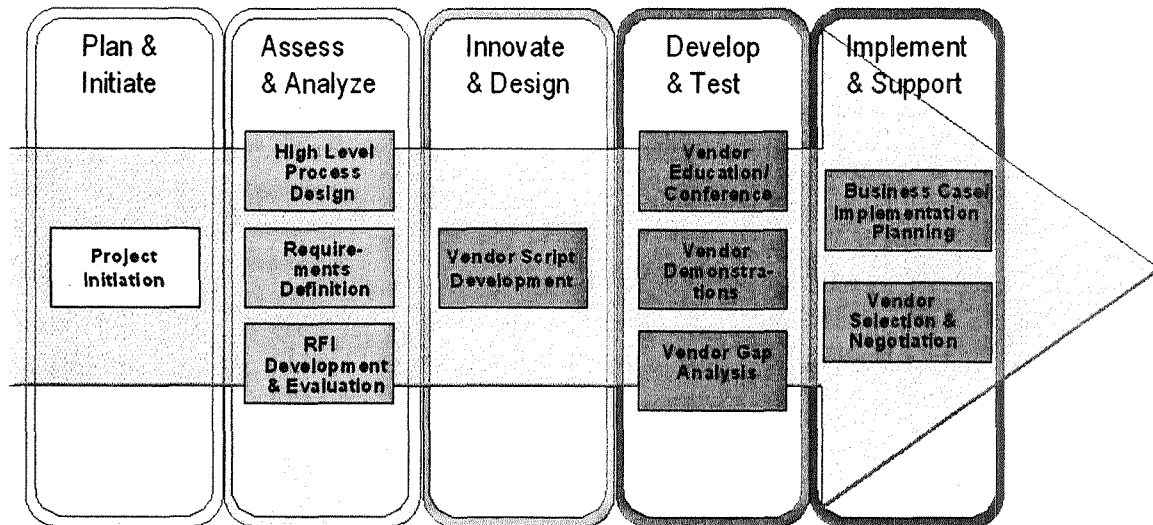
Plan & Initiate	Assess & Analyze	Innovate & Design	Develop & Test	Implement & Support
	High Level Process Design		Vendor Education/ Conference	Business Case/ Implementation Planning
Project Initiation	Require- ments Definition	Vendor Script Development	Vendor Demonstra- tions	Vendor Selection & Negotiation
	RFI Development & Evaluation		Vendor Gap Analysis	

Figure 10: SOLUTION ENGINEERING™ methodologies framework

A project plan, including a schedule, will be developed to define the detailed tasks required to complete the process modeling, requirements definition, technology assessment / evaluation, vendor coordination, test scenarios and scripts, results analysis, vendor selection and implementation.

As a result of the Phase 2 effort described above, the following documents (reports) will be developed:

✓ System Requirements Document (SRD)
✓ Process Models
✓ Data Model
✓ KM Software Evaluation Matrix
✓ Requirements Traceability Matrix
✓ KM Technology Recommendations

Upon PSD concurrence, KM technologies will be incorporated into the KM pilot functionality and evaluated against pre-defined metrics.

Next Steps - Phase 3

Phase 3 of the next steps will be to formulate the PSD KM Pilot system architecture using proven technologies and IT architecture patterns (a pattern is a proven way to solve a recurring problem). The process is organized into a series of steps:

✓ Develop architecture alternatives
✓ Select components
✓ Select architecture
✓ Develop top-level architectural solution

PSD KM system features identified for the notional system architecture will likely include a knowledge presentation layer (and its components), a knowledge network layer (and its components), a knowledge storage layer (and its components), and the User Interface. A notional system architecture is shown below as figure 11.
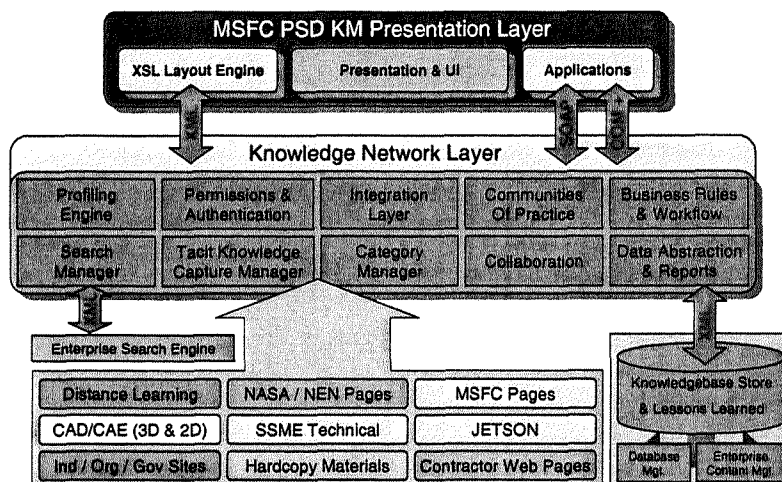
Figure 11: Notional System Architecture

After step 3, the Intergraph KM team will brief PSD executive sponsors on the outcome and the chosen solution architecture.

Next Steps – Phase 4

Intergraph follows the Capability Maturity Model (CMM) Level 3 methodology to develop software systems. Because this system is a conceptual prototype, some of the steps will not be formalized; however, all development processes will be followed. The primary steps to be completed during this phase are:

- ✓ Conduct SRR of the system requirements Spec from Phase 3
- ✓ Generate Software Design Spec (SDS)
- ✓ System and Software preliminary Design
- ✓ Conduct Preliminary Design Review (PDR)
- ✓ Complete System and Software Design
- ✓ Conduct Critical Design Review (CDR)
- ✓ Software Coding and Unit Test
- ✓ System Integration and Test
- ✓ System Deployment/Training

Next Steps – Next Development Iteration

The next Turbomachinery KM project iteration will include more advanced training concepts which will allow trainees to learn to use the PSD Failure / Anomaly Analysis process using a "case study" environment. The precise requirements for this capability will be explicitly defined under the system requirements development phase of the next project iteration. Conceptual training capabilities would include:

- ✓ The ability to train new employees on relevant Turbomachinery KM related processes via Computer-Based Training (CBT) techniques using on-line, interactive technology.
- ✓ The ability to present a case study of a past turbomachinery mishap to the trainee for analysis using the PSD Failure / Anomaly Process. Access to the relevant data and processes would be provided to allow the trainee to analyze a known failure/ anomaly in order to learn how to proficiently use the PSD analysis process and the KM system.

In Conclusion

PSD will maintain and incrementally build upon its KM successes and systems in order to add "high value" capabilities to processes, workflow, efficiency, quality and volume of work output.

PSD will continue to align its department focus with the agency Mission, Vision and Strategy by strengthening its core competencies and capabilities through the use of enabling technologies and knowledge management.

PSD will continue to embrace knowledge / change management techniques, best practices, tools and technologies as key enablers of organizational transformation, the creation of a knowledge sharing culture, and transform itself into a learning enterprise.

Acknowledgments:

The authors would like to acknowledge the contributions of the PSD KM team who supported strategic planning working sessions, surveys and interviews to formulate the PSD Knowledge Management System Strategic Evaluation Plan. These individuals will be instrumental in development of detailed systems requirements, key performance indicators, performance evaluation and results based growth of KM system functionality.

> *PSD KM Team members:*
> *Pravin Aggarwal, Eric Earhart, Eric Eberly, Sandy Elam, Darrell Gaddy, Tom Hartline, Lewis Maddux, Matthew Marsh, Katherine Mims, Rob Minor, Michael Mitchell, Tom Nesman, Robert Polsgrove, Dawn Ray, Greg Swanson*

References:

PSD Knowledge Management System, Strategic Evaluation Plan, February 10, 2006

Grant / CA # NNM05AA44G

Propulsion Systems Department

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MSFC PROPULSION SYSTEMS DEPARTMENT (PSD)

Knowledge Management (KM) Initiative

Collaborate. . .   Communicate. . .   Innovate. . .   Motivate
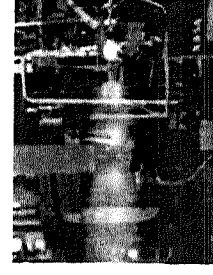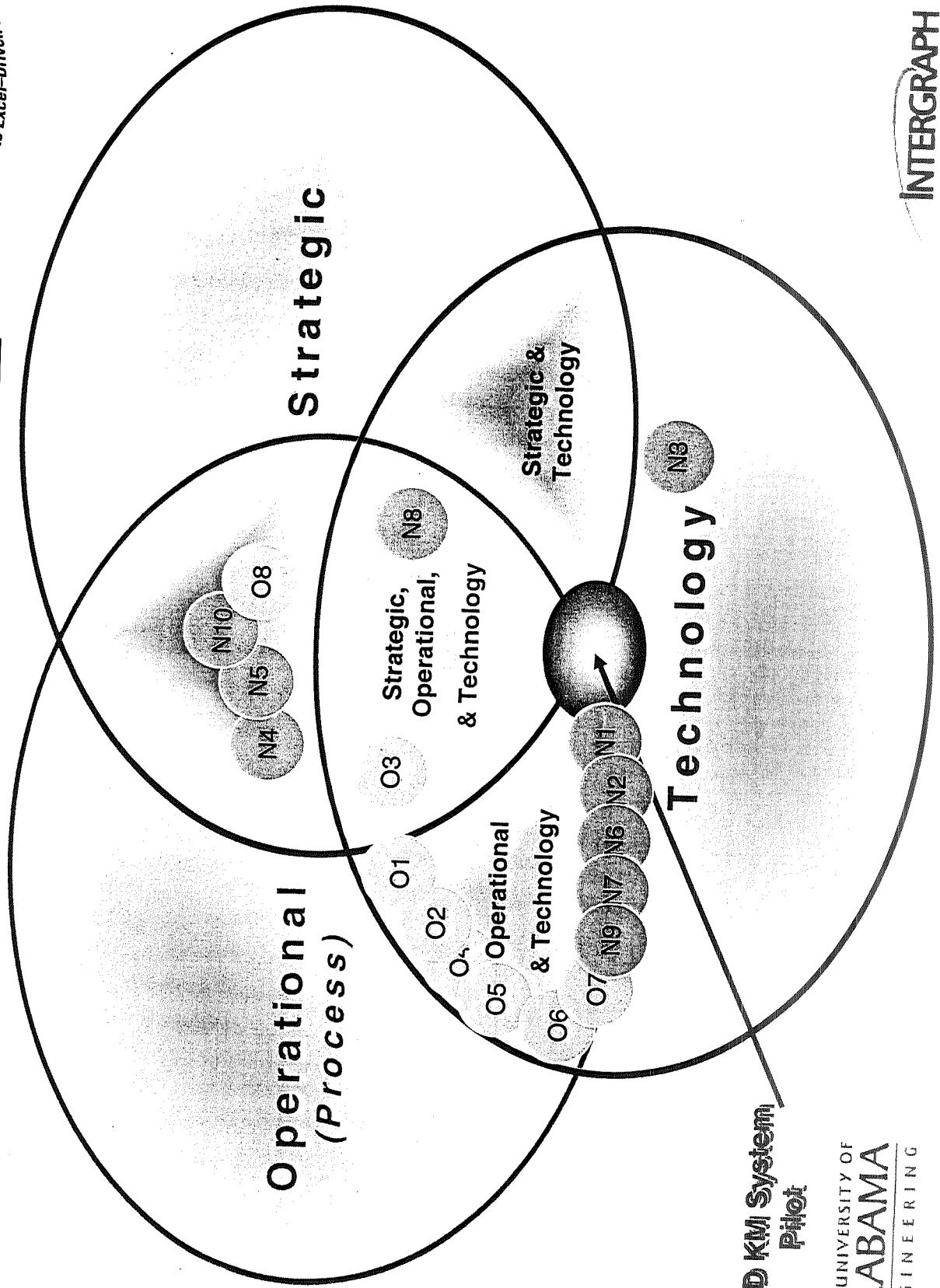
NASA

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MSFC PSD KM Strategic Plan

NASA

Strategic

Operational
(Process)

Technology

Strategic &
Technology

Strategic,
Operational,
& Technology

Operational
& Technology

N8

N3

O3

N4 N5 N10 O8

O1
O2
O4
O5
O6
O7 N9 N7 N6 N2 N1

PSD KM System
Pilot

MSFC PSD KM Strategic Plan

Strategic Plan Steps

✓ Establish PSD KM system Target Vision *(completed)*

✓ Define PSD KM System Purpose *(completed)*

✓ Develop PSD KM System Objectives *(completed)*

✓ Prioritize PSD KM System Objectives *(completed)*

- Align PSD KM mission/objectives with NASA/MSFC KM missions and objectives

- Charter and form a PSD KM Management Team

- Leverage NASA existing and future KM resources.

- Establish Key Performance Indicators (KPI's)

- Develop Stakeholder Management Strategy and Plan

- Determine what knowledge content is to be captured and managed (both explicit and tacit)

- Identify potential Communities of Practice (CoP)

- Results-Based, Deployment of KM System Functionality

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INTERGRAPH

MSFC PSD KM Strategic Plan
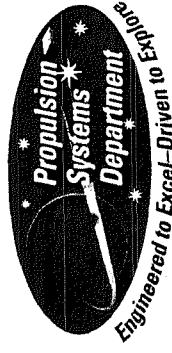
Operational Plan Steps

- Define start-up, maintenance, and expansion processes for PSD Knowledge Management implementation and support

- Identify and prioritize PSD mission-oriented processes to be supported by Knowledge Management

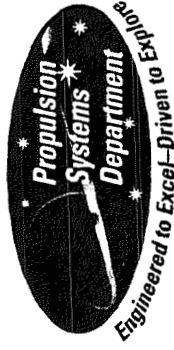- Identify and prioritize PSD support processes to be supported by Knowledge Management

MSFC PSD KM Strategic Plan

Technical Plan Steps

- Leverage *existing* collaborative technologies
- Integrate *new* collaborative technologies
- Integrate PSDs KM system with other NASA *applications*
- Implement NASA-tuned taxonomy and thesaurus
- Improve upon and grow the NASA taxonomy / thesaurus
- Negotiate better access to mission enabling contractors' databases and knowledge bases
- Link departmental portal/UI efforts to achieve greater collaboration
- Build upon existing infrastructure (physical and application) to accelerate solution delivery time and reduce costs for MSFC PSD KM Systems.
- Implement innovative, cutting edge solutions for tacit knowledge capture
- Incrementally deploy using a results driven methodology

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NASA

MSFC PSD KM Strategic Plan

KM Long-Term Strategic Deployment Roadmap

Iterative Process

Phase 1

Infrastructure Evolution

- Analyze existing NASA, MSFC, and PSD infrastructure
- Align KM and operational strategy

Phase 2

KM Systems Analysis, Requirements, Design, and Development

- Design the KM infrastructure
- Audit existing knowledge assets and systems
- Define the KM team
- Create the KM blueprint
- Develop/augment the PSD KM system

Phase 3

Deployment of Knowledge Management System

- Deploy the KM solution using a results-driven incremental methodology
- Manage change culture and reward structure

Phase 4

Evaluation of Knowledge Management Initiative

- Evaluate performance
- Measure ROI
- Incrementally refine PSD's KM system functionality

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MSFC PSD KM Strategic Plan

Next Steps

1966

21st Century
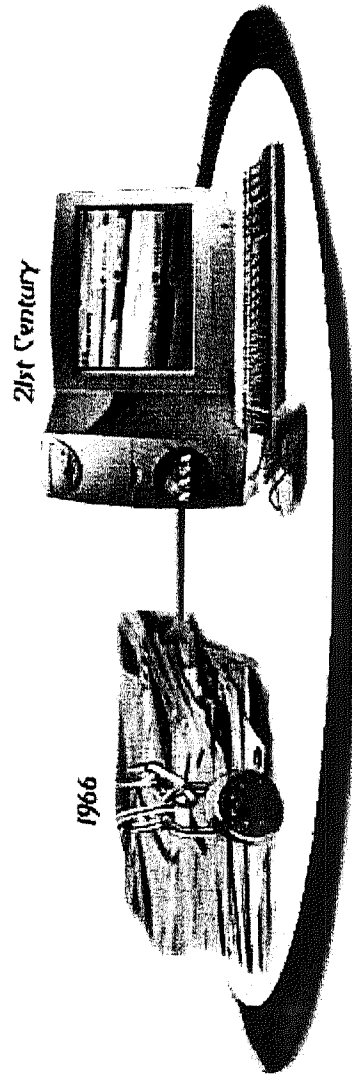
MSFC PSD KM PILOT
Project Roadmap

Phase 2 – KM Pilot Requirements Definition
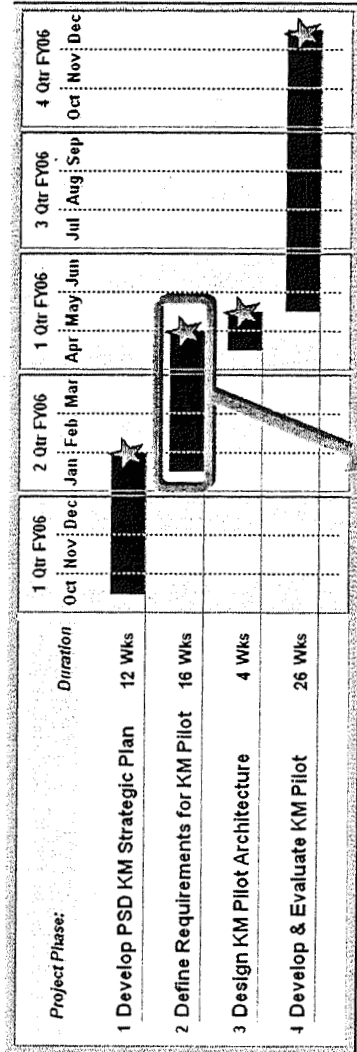
Project Phase:	Duration	1 Qtr FY06 Oct|Nov|Dec	2 Qtr FY06 Jan|Feb|Mar	1 Qtr FY06 Apr|May|Jun	3 Qtr FY06 Jul|Aug|Sep	4 Qtr FY06 Oct|Nov|Dec
1 Develop PSD KM Strategic Plan	12 Wks					
2 Define Requirements for KM Pilot	16 Wks					
3 Design KM Pilot Architecture	4 Wks					
4 Develop & Evaluate KM Pilot	26 Wks					

1. KM Architecture Guidelines / Requirements
2. NASA IT Standards, Architecture, and Security
3. Content Management
4. Taxonomy
5. Linguistics
6. Documentation Schemata
7. Business Rules
8. Personalization for Users & Disciplines
9. Vendor Qualifications, Vision, Ability to Execute

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MSFC PSD KM PILOT
Project Roadmap

Phase 3 – KM Pilot Architecture Design

Project Phase:	Duration	1 Qtr FY06 Oct Nov Dec	2 Qtr FY06 Jan Feb Mar	1 Qtr FY06 Apr May Jun	3 Qtr FY06 Jul Aug Sep	4 Qtr FY06 Oct Nov Dec
1 Develop PSD KM Strategic Plan	12 Wks					
2 Define Requirements for KM Pilot	16 Wks					
3 Design KM Pilot Architecture	4 Wks					
4 Develop & Evaluate KM Pilot	26 Wks					
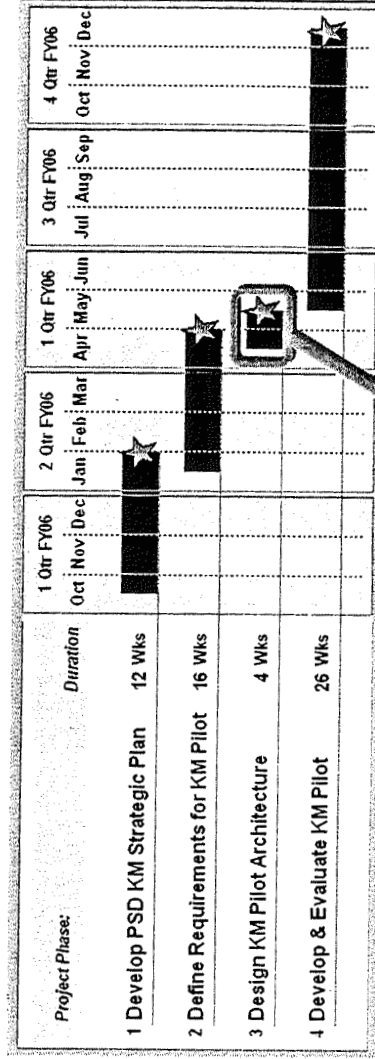
1. Develop Architectural Alternatives
2. Select Components
3. Select Architecture
4. Develop Top-Level Architectural Solution:
   - Aligned With Key Business Drivers- Supports Business Rqmnts.
   - Based On Proven Architectural Patterns
   - Well Defined To Allow Next Step Actions
   - Standards-based, Secure, Scalable, And Extendible

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MSFC PSD KM PILOT
Project Roadmap

Phase 4 – KM Pilot Development & Evaluation

Project Phase:	Duration	1 Qtr FY05 Oct Nov Dec	2 Qtr FY06 Jan Feb Mar	1 Qtr FY06 Apr May Jun	3 Qtr FY06 Jul Aug Sep	4 Qtr FY06 Oct Nov Dec
1 Develop PSD KM Strategic Plan	12 Wks					
2 Define Requirements for KM Pilot	16 Wks					
3 Design KM Pilot Architecture	4 Wks					
4 Develop & Evaluate KM Pilot	26 Wks					
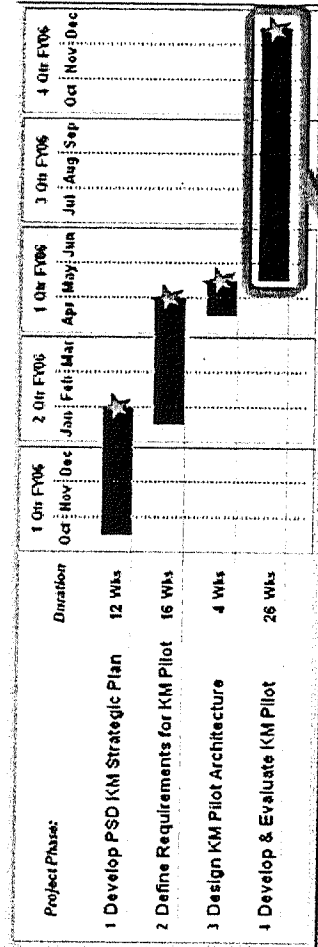
1. Conduct PDR of the System Requirements Spec (from Phase 3)
2. Generate Software Design Spec (SDS)
3. System and Software Design
4. Conduct Critical Design Review (CDR)
5. Code the software and unit test
6. System Integration and Test
7. System Deployment
8. Training
9. Notional Concepts of User Interface

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"Managing Knowledge for Successful Mission Operations"

MSFC PROPULSION SYSTEMS DEPARTMENT
Conceptual / Notional
User Interface & System Architecture
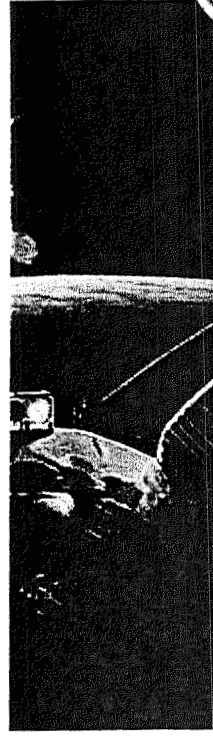
Collaborate. . .   Communicate. . .   Innovate. . .   Motivate

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MSFC PSD KM PROJECT
Conceptual User Interface

Configurable Points of Entry

✓ Integration with Existing web page (SSO)

✓ Desktop tool (ICON)

✓ Launch Bar

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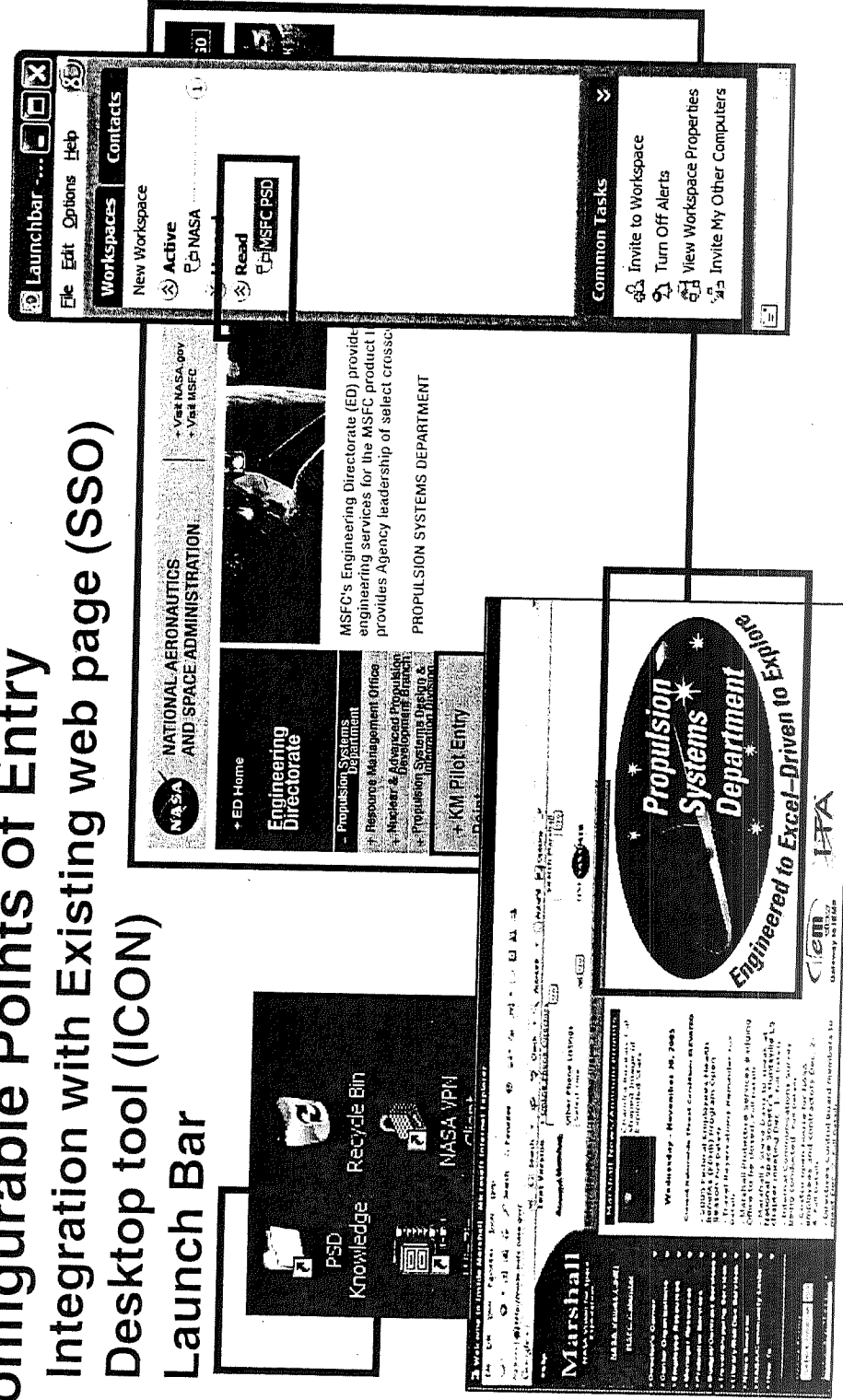
MSFC PSD KM PROJECT
Conceptual User Interface

Communities of Practice (CoP) Benefits

- Find experts to help you solve your problems
- Share information Agency-wide
- Collaborate with people of similar disciplines
- Share information in a secure collaborative environment
- Expand your data collection capabilities
- Expand your knowledge of your disciplines

Member

Edit Community Settings | Edit Business Rules | Edit Subcommunities

Ask a Question
Publish a Document
Publish a FAQ

Welcome to the PSD Turbomachinery Community

This is the source for all knowledge, experts, and resources

Other Communities:
Structural Analysis
Dynamics Analysis
Data Analysis
Safety & Mission Assurance
Program / Project Level

Home | Publications: 23 | Discussions: 11 | Members: 12 | Subcommunities: 4

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NASA

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MSFC PSD KM PROJECT
Conceptual User Interface

Communities of Practice – Collaboration
File Sharing, Tools, Favorites, Discussions & Chat
Group Calendar, Tasks, & Reminders, Discussion Forums

33
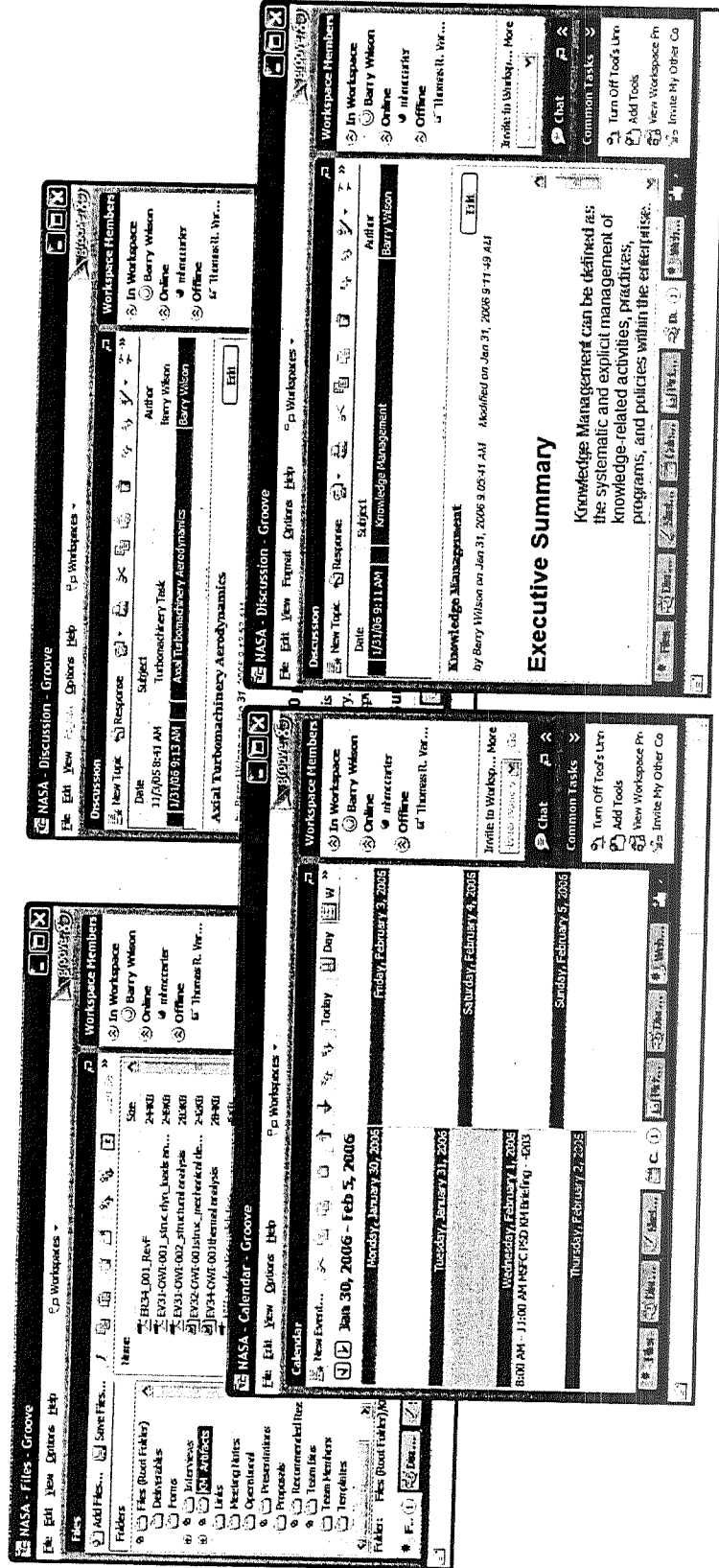
MSFC PSD KM PROJECT
Conceptual User Interface

Communities of Practice – Collaboration
Pictures, Photographs, & Images
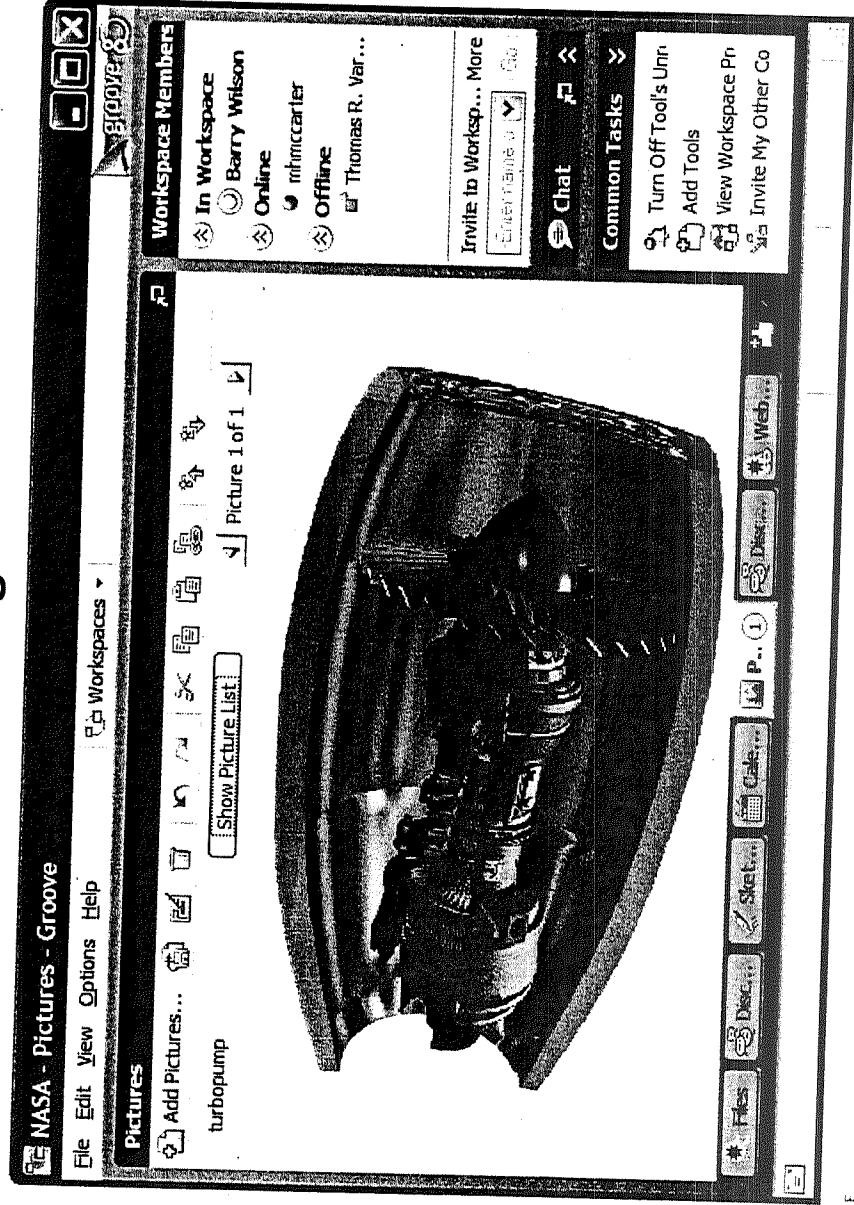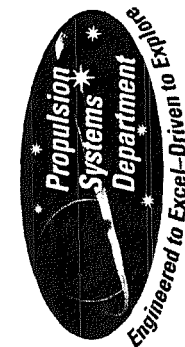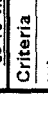
MSFC PSD KM PROJECT
Conceptual User Interface

Communities of Practice – Collaboration
"Ask a Question", Advanced Search

Ask a Question: Select Experts

Select the experts you would like to consult and click "Send Question" below.

Experts

Paul Caracciolli
I am a Consulting Manager for RobotArms products targeted towards the Automobile industry. I was the Team Lead on the large projects we hav...(more)

Stats
Rating: ☆☆☆☆☆
Avg. Reply: 29 mins
Prev. Answers: 39

Matt Marsh
I am a technical consultant worked mostly with customer industries. ...(more)

Send Question

Can't find the right expert? Find

Ask a Question: Related Resources

Here is a list of resources that might answer your question. Review the list or click "Continue" to find an expert who can answer your question.

Continue

Related Resources

➔ **Deploying in a manufacturing environment**
This covers deploying our automation system for auto manufacturer customers

Did this answer your question? **Yes**

Ⓐ **Safety process during implementation**
Q: Besides the required safety procedures, what are other recommended

Did this answer your question? **Yes**

Edit Rule: Request for proposal

▸ Go To View Rule

Criteria

When a conversation's

| Subject | ▾ | contains | Request for Proposal |

When the asker'

| | Add |

Business Rules:

...onse time
...nto exchanges

| | Add |

...ness
...nformation is kept private

| | Add |

	Added
	01/26/2002
	by Administ...
	04/25/2002
	by Lindsay....

edit

Continue

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MSFC PSD KM PROJECT
Conceptual User Interface

Communities of Practice – Collaboration
Tacit Knowledge Capture Process

Ⓐ Answered

Hi Sandra, there are a few good examples of our system customized for auto manufacturers. I was the marketing representative for the deployment team at Toyota and we have a great case study of the entire process, including time to f specific customer quotes.

Attached is the case study, which just may address all yo questions. Let me know if you need any other information AMV folks want to chat with some of our existing auto cu we can make that happen as well.

Derrik

Derrik Barton
Marketing
on 4/29/02

📎 Attachments
  📄 industry.pdf - 31 KB

This answer has been approved as RFP-ready by:

Community Discussions

Failure / Anomoly Process
Urgent | No answers | No comments | ★★★★
| 9 views

Lessons Learned
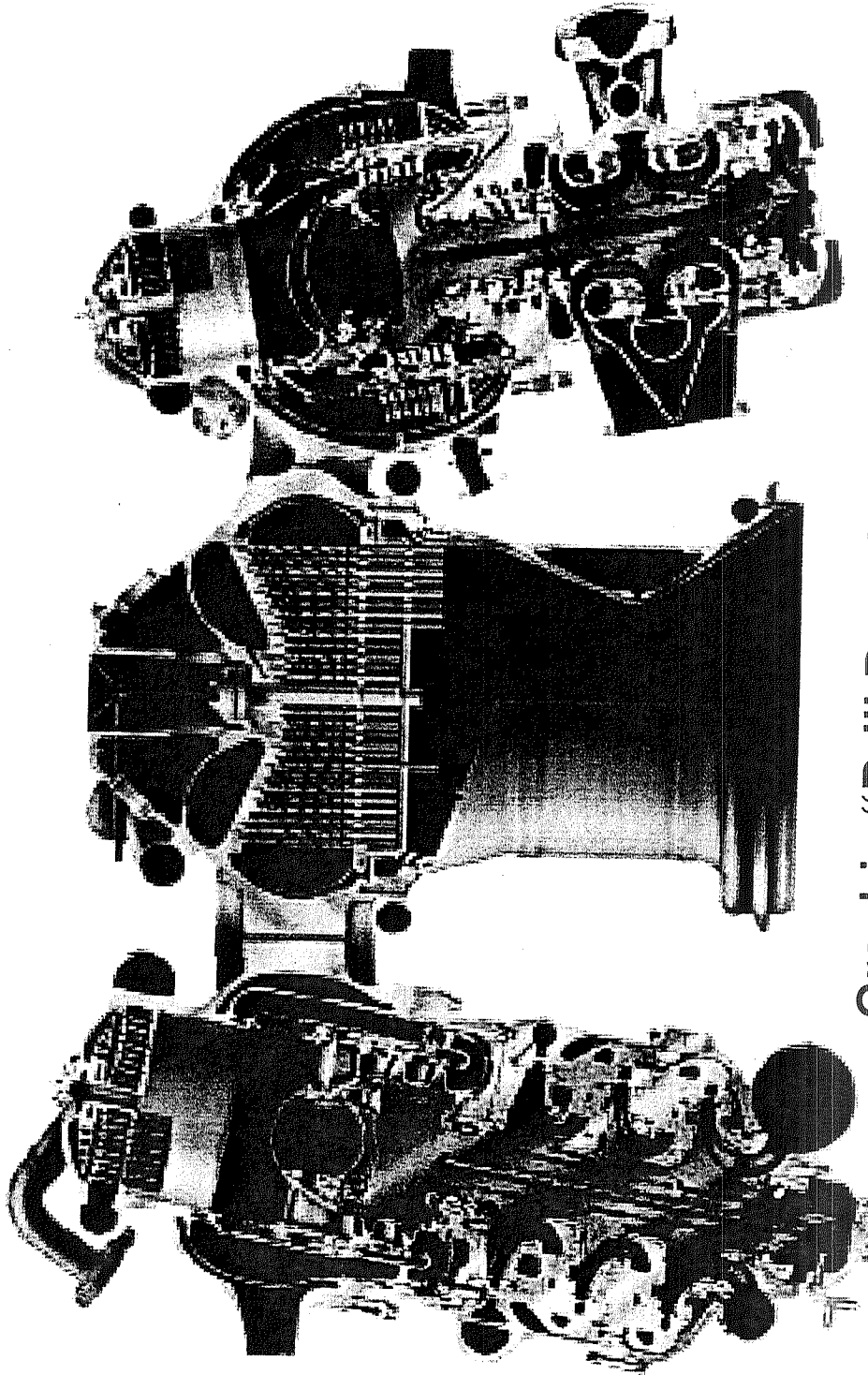Urgent | No answers | No comments | ★★★★★
| 9 views

Next Steps:

➤ Ask a follow-up question

➤ Nominate this conversation to be a Best Practice

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MSFC PSD KM PILOT
Conceptual System Architecture

MSFC PSD KM Presentation Layer

XSL Layout Engine | Presentation & UI | Applications

Knowledge Network Layer

Profiling Engine | Permissions & Authentication | Integration Layer | Communities Of Practice | Business Rules & Workflow

Search Manager | Tacit Knowledge Capture Manager | Category Manager | Collaboration | Data Abstraction & Reports

Enterprise Search Engine

Distance Learning | NASA / NEN Pages | MSFC Pages

CAD Models/Drawings | SSME Technical | JETSON

Ind./Org./Gov.Sites | Hardcopy Materials | Contractor Web Pages

Knowledgebase Store & Lessons Learned

Database Mgt. | Content Mgt.

XML | SOAP | COM+

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MSFC PSD KM PROJECT
Conceptual User Interface

Graphic "Drill Down" Capability
Browse Assembly Level

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MSFC PSD KM PROJECT
Conceptual User Interface

High Pressure Oxidizer Turbopump
- View
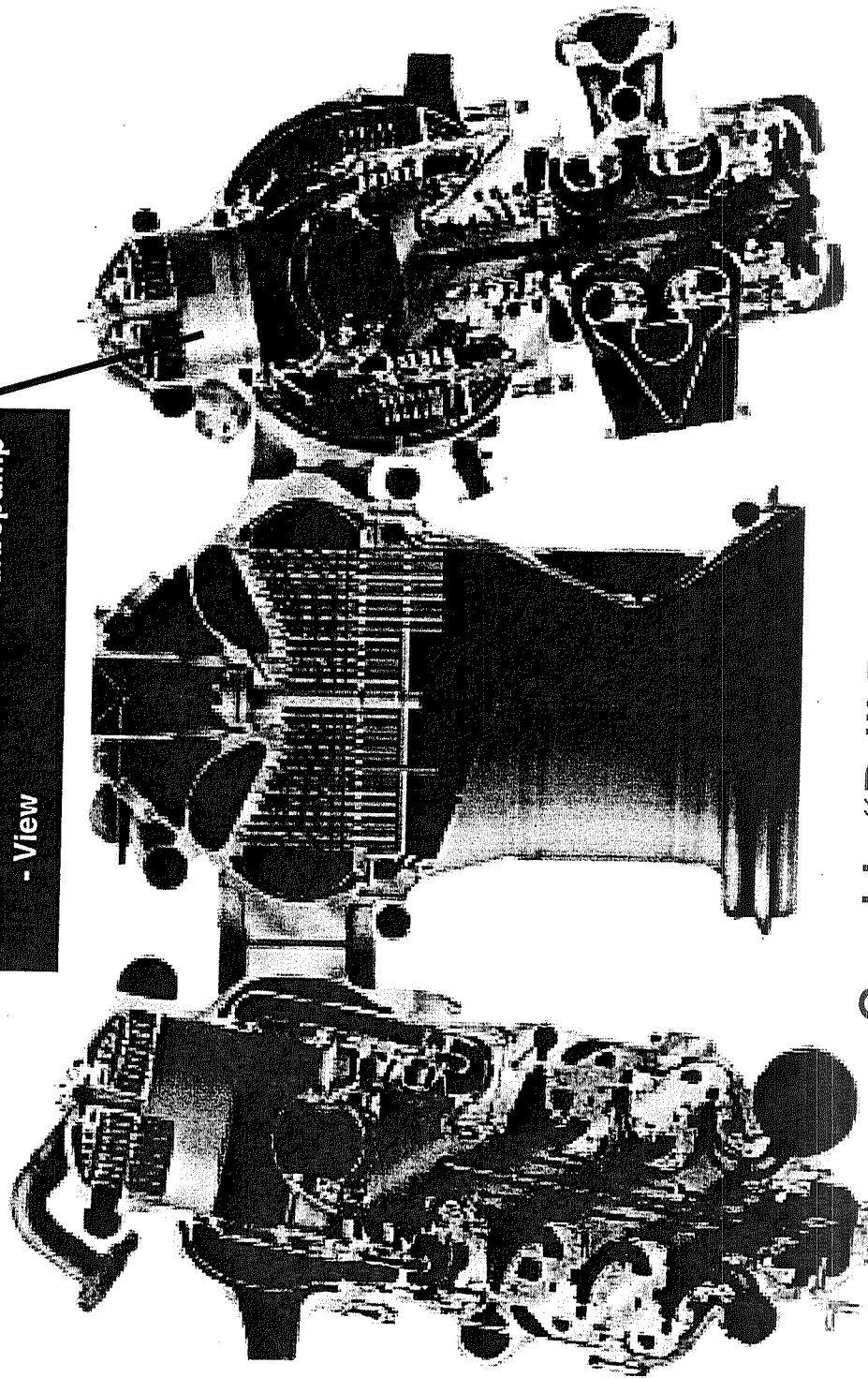
Graphic "Drill Down" Capability
Browse Assembly Level

39

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MSFC PSD KM PROJECT
Conceptual User Interface

High Pressure Fuel Turbopump - View
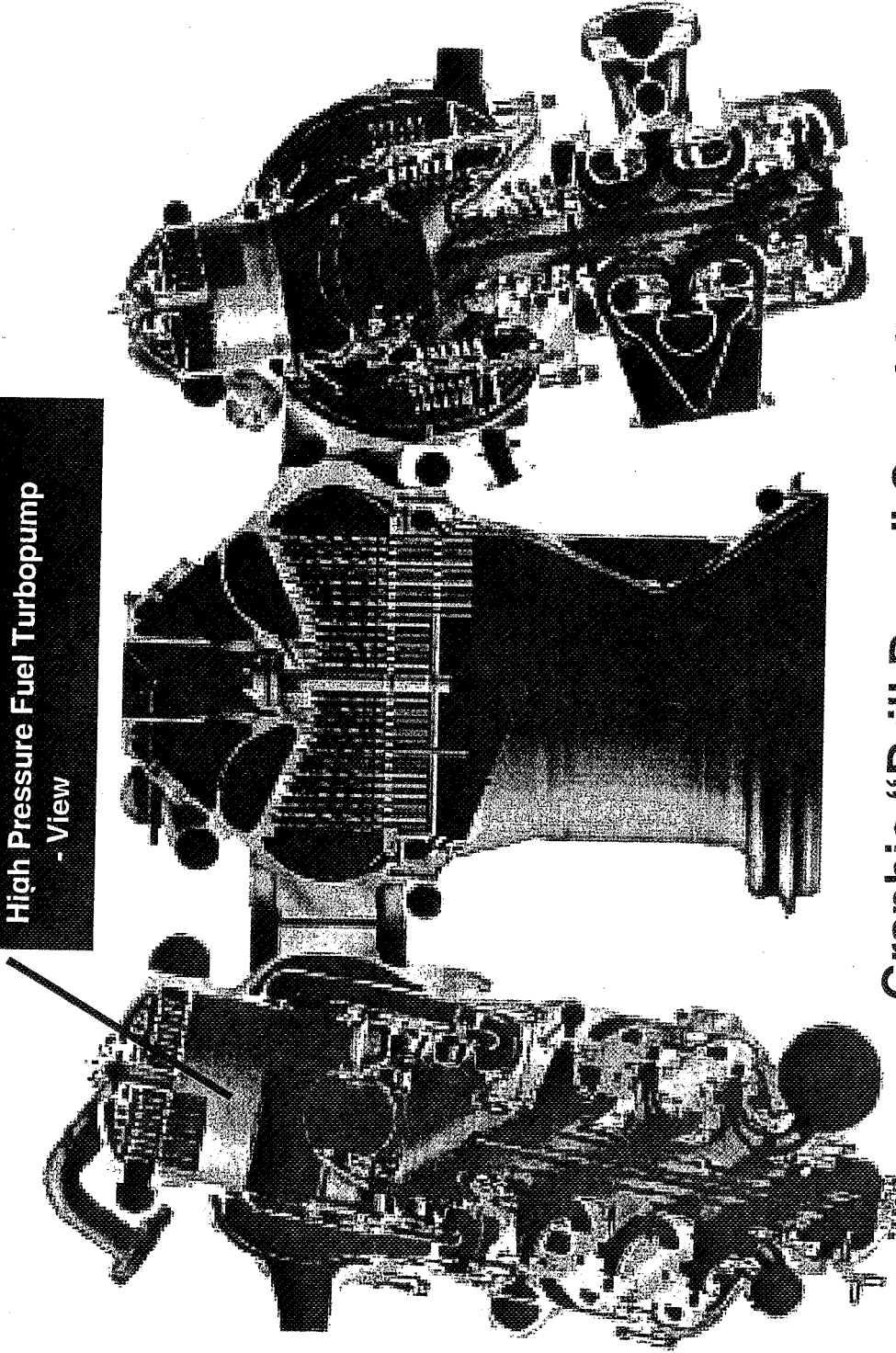
Graphic "Drill Down" Capability
Browse Assembly Level

40

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MSFC PSD KM PROJECT
Conceptual User Interface

Graphic "Drill Down" Capability
Browse Assembly Level

41
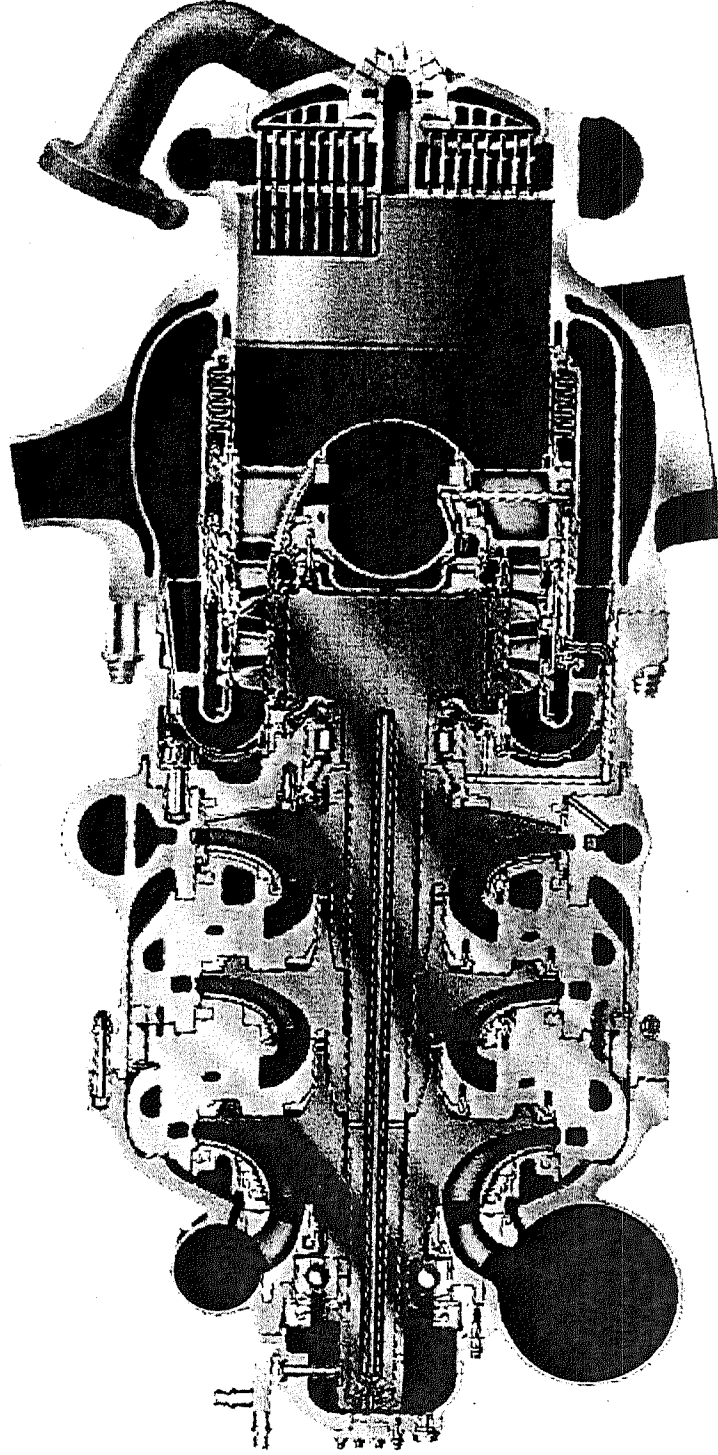
MSFC PSD KM PROJECT
Conceptual User Interface

First Stage Turbine Blade
- View Component
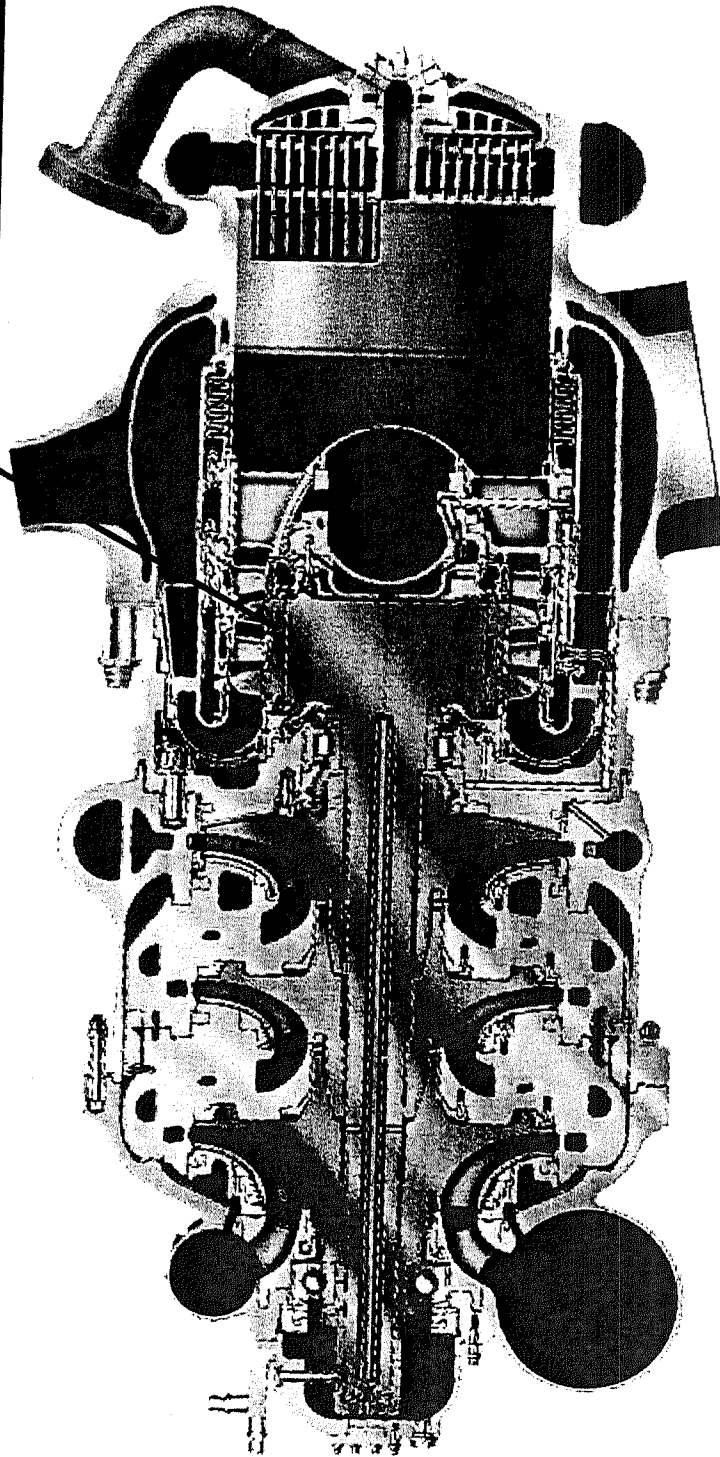
Graphic "Drill Down" Capability
Browse Assembly Level

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MSFC PSD KM PROJECT
Conceptual User Interface

Find Number: 0123456789   - Material Properties
Quantity (per build): 123456   - Technical Reports
Drawing Number: 7890-1234   - Hydrogen Flow
Material: Super Alloy

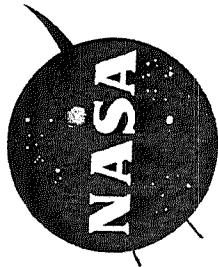Graphic "Drill - Down" Capability
Component Details View

43

MSFC PSD KM PROJECT
Conceptual User Interface
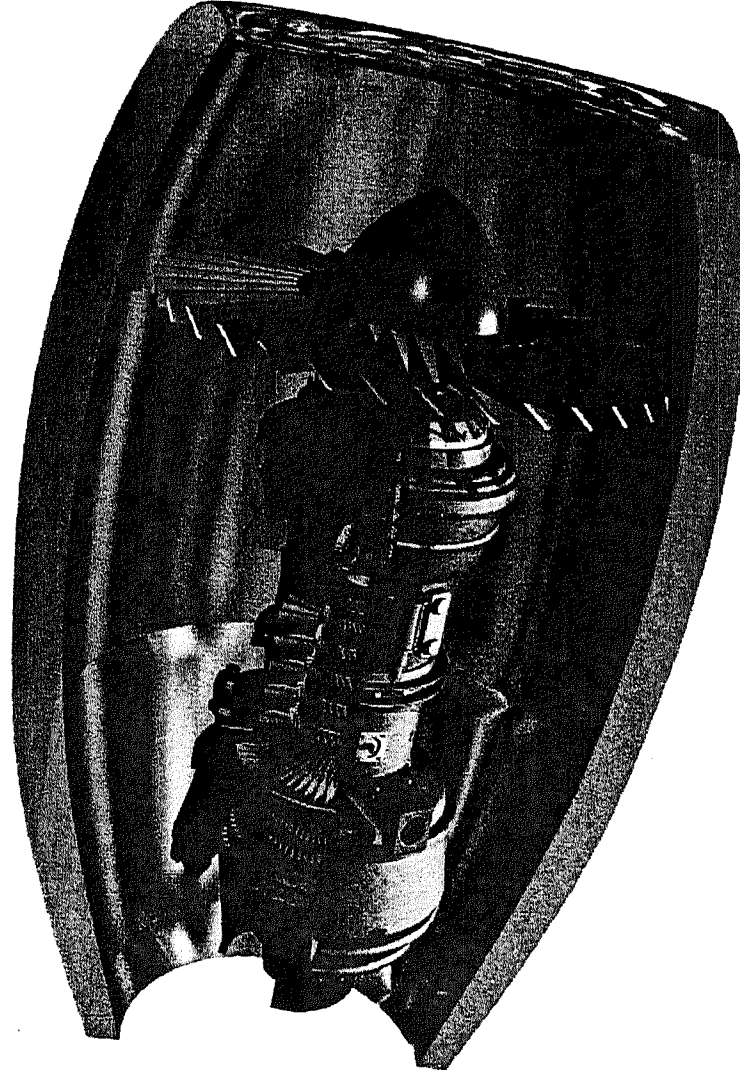
3D Turbine
Information

Graphic "Drill - Down" Capability
Resources, Links, Technical Data

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MSFC PSD KM PILOT

MSFC PSD KM Pilot Project Information -

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Questions

"Knowledge Management Is Getting The Right Information To The Right People At The Right Time."

— NASA Strategic Plan for Knowledge Management